

PARTNERSHIP COOPERATION TREATY

PCT

NOTIFICATION OF THE RECORDING
OF A CHANGE(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

Date of mailing (day/month/year) 20 February 2001 (20.02.01)	From the INTERNATIONAL BUREAU To: CABINET HIRSCH-POCHART 34, rue Bassano F-75008 Paris FRANCE
Applicant's or agent's file reference 16256 PC EIP	IMPORTANT NOTIFICATION
International application No. PCT/EP00/05436	International filing date (day/month/year) 14 June 2000 (14.06.00)

1. The following indications appeared on record concerning:

the applicant the inventor the agent the common representative

Name and Address NICOLAI, Luc, Marie, Hubert, André 492, route de Neufchateau B-6700 Heinsch Belgium	State of Nationality **	State of Residence BE
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

the person the name the address the nationality the residence

Name and Address NICOLAI, Luc, Marie, Hubert, André 492, route de Neufchateau B-6700 Heinsch Belgium	State of Nationality BE	State of Residence BE
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

3. Further observations, if necessary:

4. A copy of this notification has been sent to:
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the receiving Office the designated Offices concerned
 the International Searching Authority the elected Offices concerned
 the International Preliminary Examining Authority other:

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer F. Baechler Telephone No.: (41-22) 338.83.38
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PAJ COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION
(PCT Rule 61.2)

Date of mailing (day/month/year) 20 February 2001 (20.02.01)	ETATS-UNIS D'AMERIQUE in its capacity as elected Office
International application No. PCT/EP00/05436	Applicant's or agent's file reference 16256 PC EIP
International filing date (day/month/year) 14 June 2000 (14.06.00)	Priority date (day/month/year) 16 June 1999 (16.06.99)
Applicant NICOLAI, Luc, Marie, Hubert, André	

- 1. The designated Office is hereby notified of its election made:**

in the demand filed with the International Preliminary Examining Authority on:

12 January 2001 (12.01.01)

in a notice effecting later election filed with the International Bureau on:

- ## 2. The election X was

was

was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

<p>The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland</p> <p>Facsimile No.: (41-22) 740.14.35</p>	<p>Authorized officer</p> <p>F. Baechler</p> <p>Telephone No.: (41-22) 338.83.38</p>
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PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

CABINET HIRSCH-POCHART

34, rue de Bassano
F-75008 Paris
FRANCE



PCT

NOTIFICATION CONCERNING INFORMAL COMMUNICATIONS WITH THE APPLICANT

(PCT Rule 66.6)

Date of mailing (day/month/year)	23.03.2001
Applicant's or agent's file reference	TRANSMITTAL FOR INFORMATION
16256 PC EIP	International filing date (day/month/year)
International application no. PCT/EP00/05436	14/06/2000
Applicant E.I. DUPONT DE NEMOURS AND COMPANY	

An informal communication took place on 13/03/2001, between the International Preliminary Examining Authority and the applicant / the agent.

A copy of the note on that communication (Form PCT/IPEA/428) is herewith transmitted for your information.

Name and mailing address of the international preliminary examining authority European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Moris, A Telephone No. +49 89 2399-2973
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**Vertrag über die Internationale Zusammenarbeit auf dem Gebiet des Patentwesens
Patent Cooperation Treaty
Traité de coopération en matière de brevets**

PCT

Application No.:

PCT/EP00/05436

Note on an informal communication by telephone with the Applicant

A copy of this note is being sent to the Applicant for information

Participants

Applicant: E.I. Dupont de Nemours and Company

Agent: Pochart François

Examiner(s): Pollet, D

Summary of the communication

The authorized officer Mr Didier Pollet called the representative Mr François Pochart explaining that the closest prior art document (i.e. 'Air Entrainment with a Forced-Loaded Nip Roller', Y. Bae Chang, F. W. Chambers, J. J. Shelton, Web Handling Research Center, Oklahoma State University, 05/1994) cited in the description on page 1, l. 21, could not be retrieved by the EPO search division. Apparently, according to the Web Handling Research Center (contact Mr Y. Bae Chang), this document is proprietary information and hence not public.

This was a surprise to the representative, who promised to investigate the matter further.

If possible, a copy of the document was asked.

13/03/2001

.....
Date (day / month / year)



Pollet, D

.....
Authorized officer of IPEA

P **NT COOPERATION TREATY**
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INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 16256 PC EIP	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/EP 00/ 05436	International filing date (day/month/year) 14/06/2000	(Earliest) Priority Date (day/month/year) 06/06/1999
Applicant E.I. DUPONT DE NEMOURS AND COMPANY		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 4 sheets.

It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
 - the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).
- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :
 - contained in the international application in written form.
 - filed together with the international application in computer readable form.
 - furnished subsequently to this Authority in written form.
 - furnished subsequently to this Authority in computer readable form.
 - the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
 - the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. **Certain claims were found unsearchable** (See Box I).

3. **Unity of Invention is lacking** (see Box II).

4. With regard to the **title**,

- the text is approved as submitted by the applicant.
- the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

- the text is approved as submitted by the applicant.
- the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

- as suggested by the applicant.
- because the applicant failed to suggest a figure.
- because this figure better characterizes the invention.

1e

None of the figures.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP 00/05436

Box III TEXT OF THE ABSTRACT (Continuation of item 5 of the first sheet)

Line 9: the word "third" is replaced by the word "slender".

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 00/05436

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B65H18/26 B65H18/16

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B65H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 514 226 A (E.I. DU PONT DE NEMOURS AND COMPANY) 19 November 1992 (1992-11-19) column 6, line 17 -column 7, line 41; figures ---	1, 30, 32, 34
A	EP 0 147 115 A (E.I. DU PONT DE NEMOURS AND COMPANY) 3 July 1985 (1985-07-03) page 5, line 10 - line 34; figures 6-8 ---	1, 30, 32, 34
A	PATENT ABSTRACTS OF JAPAN vol. 95, no. 8, 29 September 1995 (1995-09-29) & JP 07 112854 A (MITSUBISHI HEAVY IND LTD), 2 May 1995 (1995-05-02) abstract ---	1, 30, 32, 34 -/-

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

° Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

Date of mailing of the international search report

25 August 2000

05/09/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
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Authorized officer

Fuchs, H

INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 00/05436

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 670 277 A (MINNESOTA MINING AND MANUFACTURING COMPANY) 6 September 1995 (1995-09-06) page 1, line 31 - line 38; figures -----	1, 30, 32, 34

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP 00/05436

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
EP 0514226 A	19-11-1992	FR	2676427 A	20-11-1992
		CA	2068755 A	18-11-1992
		JP	5147787 A	15-06-1993
EP 0147115 A	03-07-1985	US	4850545 A	25-07-1989
		CA	1263856 A	12-12-1989
		DE	3469350 D	24-03-1988
		JP	60137746 A	22-07-1985
JP 07112854 A	02-05-1995	NONE		
EP 0670277 A	06-09-1995	CA	2141924 A	03-09-1995
		DE	69512106 D	21-10-1999
		DE	69512106 T	09-03-2000
		JP	7268291 A	17-10-1995
		US	5755905 A	26-05-1998

PATENT COOPERATION TREATY

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REC'D	U 8 AUG 2001
WIPO	PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 16256 PC EIP	FOR FURTHER ACTION		See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/EP00/05436	International filing date (day/month/year) 14/06/2000	Priority date (day/month/year) 16/06/1999	
International Patent Classification (IPC) or national classification and IPC B65H18/26			
Applicant E.I. DUPONT DE NEMOURS AND COMPANY			

<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 7 sheets, including this cover sheet.</p> <p><input type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of sheets.</p>
<p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> I <input checked="" type="checkbox"/> Basis of the report II <input type="checkbox"/> Priority III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability IV <input type="checkbox"/> Lack of unity of invention V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement VI <input type="checkbox"/> Certain documents cited VII <input checked="" type="checkbox"/> Certain defects in the international application VIII <input checked="" type="checkbox"/> Certain observations on the international application

Date of submission of the demand 12/01/2001	Date of completion of this report 06.08.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Pollet, D Telephone No. +49 89 2399 7516



**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/EP00/05436

I. Basis of the report

1. With regard to the elements of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):
Description, pages:

1-12 as originally filed

Claims, No.:

1-42 as originally filed

Drawings, sheets:

1/6-6/6 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- the language of publication of the international application (under Rule 48.3(b)).
- the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- contained in the international application in written form.
- filed together with the international application in computer readable form.
- furnished subsequently to this Authority in written form.
- furnished subsequently to this Authority in computer readable form.
- The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- the description, pages:
- the claims, Nos.:

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/EP00/05436

- the drawings, sheets:
5. This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)): *(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*
6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims 1-42
	No:	Claims
Inventive step (IS)	Yes:	Claims 1-42
	No:	Claims

2. Citations and explanations *see separate sheet*

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/EP00/05436

R It m V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. The document 'Air Entrainment with A Forced-Loaded Nip Roller', Y. Bae Chang, F. W. Chambers, J. J. Shelton; Web Handling Research Center, Oklahoma State University, 05/1994, which is cited in the description on p. 1, l. 21 and which is regarded as the closest prior art, discloses two schematic designs including a slender roll in a web winding apparatus in order to reduce possible air entrainment between each web layer on the winding roll. The second design shows a slender roll between two rolls and a winding roll, the web passing from one of those rolls to the slender roll and then to the winding roll. Apparently, according to the application (see p. 2, l. 4-5), this document does not give enough hints to put those principles into practice.

The problem the present invention seeks to solve is to put those principles (i.e. two rolls with a slender roll in between) into practice.

The solution is given by an apparatus for winding a web according to claim 1 and three methods configuring the web through the apparatus according to claims 30, 32 and 34.

No hint or indication to the above mentioned feature was found in the teachings of the cited prior art documents, which describe winding apparatuses having maximum two rolls. It should be noted however that the prior art document cited in the description on p. 1, l. 21 could not be retrieved by the ISA and that, on request of the authorized officer of the IPEA, the applicant failed to provide a copy of this prior art document. Hence, the IPEA could not verify if, having regard this document, it would not be obvious to a person skilled in the art to put those principles into practice.

Consequently, **having regard to the available prior art (i.e. the document described in the description on p. 1-2 not included)**, the subject-matter of independent apparatus claim 1 and independent method claims 30, 32 and 34 appears to be new and to involve an inventive step within the meaning of Articles

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/EP00/05436

- 33(2) and 33(3) PCT.
2. The dependent apparatus claims 2-29 and dependent method claims 31, 33 and 35-42 relate respectively to particulate embodiments of the apparatus and methods and likewise appear to meet the requirements of Articles 33(2) and 33(3) PCT.
 3. Since it appears that the claimed invention can be made or used in a technological sense in industry, the claimed invention appears to have industrial applicability within the meaning of Article 33(4) PCT.

Re Item VII

Certain defects in the international application

Independent claim 1 is not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art being placed in the preamble (Rule 6.3(b)(i) PCT) and with the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).

According to the requirements of Rule 11.13(m) PCT the same feature shall be denoted by the same reference sign throughout the application. This requirement is not met in view of the following:

- p. 6, l. 4: 'slender roll 25' should be 'slender roll 5';
- p. 6, l. 19 (see also claim 7): 'Pressure cylinders 19, 20 and 21' should be 'Pressure cylinders 19, 21 and 23';
- p. 11, l. 8: 'carriage 6' should presumably read 'carriage of roll 6'.

The following typographical errors have been found in the application:

- p. 10, l. 36: this should presumably read 'rolls 4, 6 and 7 on the other side...';
- p. 12, l. 1-2: '...towards slender roll 5 and rolls 4 and 3...';
- claim 1, l. 23 and claim 7, l. 16: there appears to be a full stop respectively after '(4)' and '(2)'.

R It m VIII

Certain observations on the international application

1. Although method claims 30, 32 and 34 have been drafted as separate independent claims, they appear to relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought. The aforementioned claims therefore lack conciseness. Moreover, lack of clarity of the claims as a whole arises, since the plurality of independent claims makes it difficult to determine the matter for which protection is sought, and places an undue burden on others seeking to establish the extent of the protection.

Hence, claims 30, 32 and 34 do not meet the requirements of Article 6 PCT.

2. The application does not meet the requirements of Article 6 PCT, because claims 1, 2, 15, 18 and 42 are not clear for the following reasons:

If understood correctly, it appears that there are two 'second angles' possible since there are two intersection lines. Hence, the definition of 'a second angle' is vague and unclear and leaves the reader in doubt as to which angle is referred, thereby rendering the definition of the subject-matter of said claim unclear. Further, the feature 'wherein said web passes at least between said third roll (5) and said winding roll (2)' in the apparatus claim 1 relates to a method of using the apparatus rather than clearly defining the apparatus in terms of its technical features. The intended limitations are therefore not clear from this claim.

With regard to claim 2, it is not clear what is to be understood by '...the bearings of *at least one roll* among...being movable'. If the rolls (3-5) are located out of the path of the web should they not all be movable?

Regarding claim 15, the feature of the axis of the winding roll (2) being located at a higher level than the axis of the third roll (5) appears not referred to in the description. Claim 15 is therefore not supported by the description as required by Article 6 PCT.

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/EP00/05436

Claim 18, referring back to any one of claim 1 to 17, states that 'when said third roll (5) is in direct contact with said first or second roll (3, 4,...)'.

However, this is inconsistent with claim 1, which claims that 'said first and second rolls (3, 4) and said winding roll (2) are each in contact with said third roll (5)'.

Claim 42, referring to any one of claims 30 to 41, states that 'said web (1) is caused to arrive on said first or second roll (3, 4) substantially perpendicular'. However, this appears to be impossible when referring to claim 30, which states that the web passes neither between said second and third rolls (4, 5), nor between said first and third rolls (4, 5).

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
21 December 2000 (21.12.2000)

PCT

(10) International Publication Number
WO 00/76894 A1

(51) International Patent Classification⁷: **B65H 18/26, 18/16** Luc, Marie, Hubert, André [—/BE]; 492, route de Neufchateau, B-6700 Heinsch (BE).

(21) International Application Number: **PCT/EP00/05436**

(74) Agent: **CABINET HIRSCH-POCHART**; 34, rue Bas-sano, F-75008 Paris (FR).

(22) International Filing Date: 14 June 2000 (14.06.2000)

(25) Filing Language:

English

(81) Designated States (*national*): CN, JP, KR, US.

(26) Publication Language:

English

(84) Designated States (*regional*): European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

(30) Priority Data:
99401483.5 16 June 1999 (16.06.1999) EP

Published:

— With international search report.

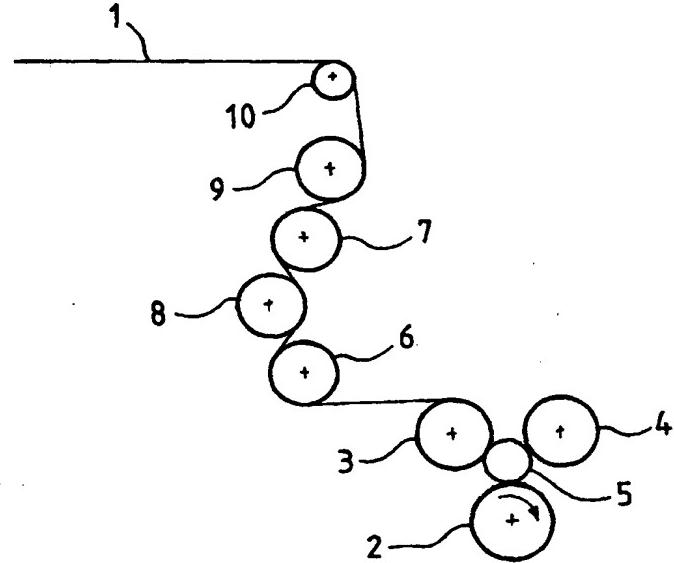
(71) Applicant (*for all designated States except US*): **E.I. DUPONT DE NEMOURS AND COMPANY [US/US]; 1007 Market Street, Wilmington, DE 19898 (US)**.

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(72) Inventor; and
(75) Inventor/Applicant (*for US only*): **NICOLAI**,

(54) Title: APPARATUS AND METHOD FOR WINDING OF WEBS

WO 00/76894 A1



(57) Abstract: The apparatus for winding a web (1) on a winding roll (2), comprises at least a first and a second roll (3, 4) and a slender roll (5), said first roll being located on one side and said second roll and said slender roll being located on the other side of the path of said web in course of winding on said winding roll. Said first and second rolls and said slender roll are movable towards each other and towards said winding roll, so that said slender roll get sandwiched between said winding roll on one hand and said first and second rolls on the other hand, said web passing between said first roll and said slender roll and then between said second roll and said winding roll. Means cause said slender roll to position and align freely between said first and second roll and said winding roll.

APPARATUS AND METHOD FOR WINDING OF WEBS

5

FIELD OF THE INVENTION

The invention relates to an apparatus and a method for winding of webs.

BACKGROUND OF THE INVENTION

10 In general, webs such as thin polyester foils or other sheet materials are manufactured in a continuous process and the final products are wound up on rolls for storage and transportation.

15 During the operation of winding the web on a roll, it is wished to ensure an homogeneous winding on the roll (i.e. without wrinkles or puckers) and to trap as less as possible air between each web layer on the roll.

The problem is particularly acute for (ultra) thin films with thickness as low as the micron size and speeds up to 1000 m/min.

20 In the prior art, webs, especially in case of thin ones, are usually wound at high velocities (i.e. more than a few hundred meters per minute) with the help of a nip roller (also called packroll) to prevent excessive air entrainment.

In p. 33 to 35 of Air Entrainment with A Forced-Loaded Nip Roller, Y. Bae Chang, F. W. Chambers, J. J. Shelton, Web Handling Research Center, Oklahoma State University, 05/1994, it is taught that :

25 (aa) to keep the amount of air entrainment under a certain level at high speed operation, the most effective way is to reduce the diameter of packroll ;

(bb) if the packroll (or its covering) is softer than the winding roll and too much air is entrained, then the problem can be solved by using harder materials for the packroll ;

30 (cc) the amount of entrainment air is not very effectively reduced by increasing the nip loading and if said loading is increased too much, other winding problems can occur.

Furthermore, this document teaches that there may be practical problems or limitations in reducing the size of packrolls, for example, the packroll may become too flexible if it is too thin. However, it suggests to design slender packrolls because 35 of its importance in air entrainment and gives two examples of possible design changes by way of schematic drawings. A first drawing shows a slender roll between a roll and a winding roll, the web passing from the roll to the slender roll and then to the winding roll. A second drawing shows a slender roll between two rolls and a

CONFIRMATION COPY

winding roll, the web passing from one of those rolls to the slender roll and then to the winding roll.

However, this document does not give enough hints for to put those principles into practice, i.e. there are several practical problems that are neither solved nor mentioned. A first problem is to ensure the correct position of the slender roll between the roll(s) and the winding roll since the slender roll becomes flexible due to its low diameter. Another problem is to ensure that the tangential speed of the slender roll and of the rolls is identical at each point there between over their length in order to avoid friction on the web. Another problem is to ensure the spreading of the web before winding it on the winding roll, i.e. wrinkles may remain on the web once wound on the winding roll. A further problem is to allow an easy initiation of the winding of the web: the difficulty consists in passing the web between the roll and the slender roll and between the slender roll and the winding roll. Another further problem is to apply a pressure distribution over the width of the winding roll that results in a uniform air exclusion.

The purpose of the present invention is to provide an apparatus and a method for winding webs on winding rolls which overcome these problems.

20

SUMMARY OF THE INVENTION

The object of the present invention is to provide an apparatus and a method for winding of webs on winding rolls ensuring a good and uniform air exclusion, no distortion of the web, a good spreading of the web as well as an easy initiation of the winding thereby improving the speed and the quality of the winding.

The object is achieved with an apparatus according to claim 1 and a method according to claim 30, 32 or 34. Preferred embodiments are defined in the depending claims.

30

BRIEF DESCRIPTION OF THE DRAWINGS

Figures 1a to 1e are schematic side views of the rolls of an apparatus according to the invention, illustrating the operating of said apparatus;

Figure 2 is a schematic side view showing the mechanical links between the rolls and the carriages;

Figure 3 is a schematic side view of the lower parts of the supports which interlock;

Figure 4 is a schematic side view for an alternative embodiment of the invention;

Figure 5 is a schematic side view for another alternative embodiment of the invention;

- 5 Figure 6a and 6b show alternative possibilities to thread up the web through the rolls of an apparatus according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

Figs. 1a to 1e show the operation of a preferred embodiment of an apparatus 10 according to the invention from the open state allowing the initiation of the winding on the winding roll till the working position for ensuring a winding of high quality for thin webs (down to about a micron for polyester webs) at high speeds (up to 1000 m/min).

15 Fig. 1a shows an apparatus according to the present invention in open position. A web 1 such as a polyester foil arrives from a conveyance direction indicated by arrow F. As the apparatus is in open position, the web is diverted towards a winding roll 2 (located in a lower position) via, for example, an idle roll 10 (which is fixed). The path between idle roll 10 and winding roll 2 is free in order to 20 allow an easy initiation of the winding of web 1 on winding roll 2, either manually or by automatic means. A first set of rolls (3, 8, 9) is provided on one side of said path. Said first set of rolls is carried by a first movable carriage 11 (not shown). A second set of rolls (4, 5, 6, 7) comprising a slender roll 5, is provided on the side opposite to 25 said first set of rolls with respect to said path. Said second set of rolls is carried by a second movable carriage 12 (not shown).

Once the winding of web 1 on winding roll 2 is initiated, first carriage 11 is moved towards the portion of web 1 extending between idle roll 10 and winding roll 2, till a position in which roll 3 abuts web 1. This situation is illustrated in fig. 1b. 30 Before abutting web 1, roll 3 is preferably caused to rotate with a tangential speed and in a direction substantially corresponding to those of the displacement of web 1. Rolls 8 and 9 are shown not abutting web 1, however, it may be the case.

Once at the stage of fig. 1b, second carriage 12 is moved towards web 1 till a 35 defined position in which roll 3 and roll 4 are narrow, but not into contact with each other. This situation is illustrated in Fig. 1c. For sparing operating time, this step (i.e. moving second carriage 12 towards web 1) may be realized simultaneously with the previous one consisting in the displacement of carriage 11 towards web 1. The

simultaneous displacement of first carriage 11 and second carriage 12 is indeed preferred. In the position of Fig. 1c, slender roll 5 is preferably located under roll 4 slightly towards roll 3, i.e. slender roll 5 abuts roll 4 but does not abut roll 3. Neither roll 4 nor slender roll 5 abut web 1. Rolls 8 and 9 of the first carriage 11 and rolls 6 and 7 of the second carriage 12 are located so as to form a jaw having been closed on the web. More precisely, roll 7 of the second carriage 12 is located substantially between roll 8 and roll 9 of the first carriage 11, and preferably in a narrow fashion but without being into contact with them. Roll 6 of the second carriage 12 is substantially located under roll 8 of the first carriage 11 and preferably close to the latter. Thus, web 1 is caused to abut roll 9 and to pass from roll 9 on roll 7, from roll 7 on roll 8, from roll 8 to roll 6 so as to form waves. The jaw defined by rolls 6, 7, 8 and 9, when closed onto web 1, isolates the winding tension from the incoming tension, which might be too low or too high. It is possible to vary the number of rolls forming said jaw. Further, before abutting web 1, rolls 6, 7, 8 and 9 are preferably caused to rotate each with a tangential speed and in a direction corresponding to that of web 1 (so as to avoid friction between said rolls and web 1); so, excessive tension on web 1 at the moment of being abutted by said rolls (which could arise if said rolls were idle rolls) are avoided. For web 1 having a width up to 2 meters and being conveyed at a speed up to 1000 meters/min, it is advantageous for rolls 6, 7, 8 and 9 having a diameter of about 120 millimeters. Preferably, roll 6 is horizontally spaced from roll 3 so that web 1 passes from roll 6 to roll 3 in a substantially horizontal fashion. Furthermore, roll 3 and roll 4 are preferably interlocked in this position in order to avoid relative change of position between them as it will be described in relation with Fig. 3.

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Once at the stage of Fig. 1c, roll 4 is preferably caused to rotate with a tangential speed corresponding to the speed of web 1 and in the same direction than roll 3. As a result, roll 4 causes slender roll 5 to rotate by friction driving because slender roll 5 abuts roll 4. Slender roll 5 is then moved upwards along the circumference of roll 4 until it abuts roll 3 through web 1. Hence, slender roll 5 is in abutment both with roll 3 (through web 1) and roll 4, and, as a consequence, slender roll 5 is precisely positioned by those rolls 3 and 4. Web 1 passes now from roll 3 to slender roll 5 and then to winding roll 2. The axis of slender roll 5 and the axis of winding roll 2 are preferably contained in a substantially vertical plane. This situation is illustrated in Fig. 1d.

Once at the stage of Fig. 1d, the block formed by carriages 11 and 12 is lowered (i.e. the whole roll assembly) till slender roll 5 abuts winding roll 2,

preferably at its top. This situation is illustrated in Fig. 1e. As it can be taken from Fig. 1e, rolls 3 and 4 do not abut winding roll 2. This lowering may be achieved e.g. by a main carriage (not shown) movable vertically, on which carriages 11 and 12 are slidably mounted in the horizontal direction (to allow their displacement towards web 1 mentioned in relation with Fig. 1a to Fig. 1c). Just before slender roll 5 abuts winding roll 2, preferably at a distance of about 10 millimeters, the driving in rotation of rolls 3 and 4 is preferably stopped so as to act now as idle rolls; this may be classically achieved by disengagement of a clutch mechanism. When the apparatus is in position of Fig. 1e, it is in nominal position for winding efficiently 10 web 1 on winding roll 2 and slender roll 5 acts as a nip roller.

During each of these steps from Fig. 1a to Fig. 1e, the rotation speed of winding roll 2 is preferably varied so as to keep a substantially constant tension of web 1 as the length of the path of web 1 varies during the deviation of web 1 by the various rolls of the apparatus. For instance, this may be achieved by controlling the 15 rotation speed of winding roll 2 as a function of the force exerted by web 1 on roll 6, during the steps described in relation with fig. 1c, 1d and 1e.

Referring now to Fig. 2, we will now describe the mechanism for ensuring the 20 correct positioning of slender roll 5 between rolls 3 and 4. Fig. 2 shows only a part of the apparatus relatively to rolls 3 and 4 and slender roll 5 when the apparatus is in the position of Fig. 1c. Slender roll 5 (its axis is referenced 31) is held on each end through a corresponding double acting pressure cylinder 19. More precisely, each 25 end of slender roll 5 is articulated on the end of the rod 20 of a respective pressure cylinder 19. Pressure cylinders 19 preferably extend substantially vertically with their rods 20 extending downwards. Each pressure cylinder 19 is preferably fixed on the end of a respective arm 27 which is linked to carriage 12 via a respective pivot link 28. Pivot links 28 are preferably arranged in the middle region of arms 27. The opposed end of each arm 27 is linked on the rod 26 of a respective pressure cylinder 30 via a pivot link 29. Pressure cylinders 25 are both linked on carriage 12 via 35 respective pivot links 30. Pressure cylinders 25 preferably extend substantially horizontally. This construction allows to change the horizontal and vertical position of slender roll 5 by controlling pressure cylinders 19 and 25. Thus, when passing from the position of Fig. 1b to the position of Fig. 1c, slender roll 5 is positioned correctly under roll 4, i.e. without slender roll 5 abutting web 1, by causing rods 20 and 26 of pressure cylinders 19 and 25 to the extended position. Then, to pass from the position of Fig. 1c to the position of Fig. 1d, rods 20 are caused to retract and thus, slender roll 5 runs along the circumference of roll 4 until it abuts also roll 3

through web 1; during this operation, pressure in pressure cylinders 25 is controlled in known manner in order to maintain slender roll 5 in abutment on roll 4 without excessive strength. Preferably, once slender roll 5 abuts roll 3, no pressure is anymore applied to pressure cylinder 25 so that slender roll 25 is positioned only by rolls 3 and 4 through the pulling forces of pressure cylinders 19.

During winding, i.e. in the position of Fig. 1e, pressure cylinders 19 remain retracted to keep both ends of slender roll 5 in abutment with rolls 3 and 4 regardless of the width of winding roll 2.

As regards rolls 3 and 4, they are both rotatably mounted on respective supports 13 and 14, their axis being referenced 17 and 18. Supports 13 and 14 cooperate so as to define an interlocking mechanism for interlocking roll 3 with roll 4 as already mentioned: this will be described more precisely in relation with Fig. 3. Supports 13 are slidably mounted in the vertical direction on carriage 11 (the guiding means are not shown) and are vertically positioned through e.g. double acting pressure cylinders 21. Similarly, supports 14 are slidably mounted in the vertical direction on carriage 12 (the guiding means are not shown) and are vertically positioned through e.g. pressure cylinders 23. So, pressure cylinders 21 and 23 extend parallel and vertically with their respective rods 22 and 24 extending downwards. Pressure cylinders 19, 20 and 21 automatically take up the diameter increase of winding roll 2. However, they are only used for to lift rolls 3 and 4 and slender roll 5 over a defined detected distance corresponding to e.g. a few millimeters. After that, it is the whole block formed of carriages 11 and 12 which is lift over said defined height and blocked in this new position while pressure cylinders 19, 21 and 23 maintain rolls 3 and 4 in abutment with slender roll 5 and slender roll 5 in abutment with winding roll 2. From there on, pressure cylinders 19, 21 and 23 again take up the diameter variation of winding roll 2 until being retracted again from said defined distance after what the whole block is again lifted and so on.

Referring to Fig. 3, we will now describe the interlocking mechanism of roll 3 with roll 4 which is active in the state of the apparatus shown in Fig. 1c to 1e. Fig. 3 is a schematic side view showing the lower part of support 13 carrying roll 3 (its axis being referenced 17) and the lower part of support 14 carrying roll 4 (its axis being referenced 18). The lower part of support 13 exhibits an arm 13a extending laterally towards support 14. A groove 15 is arranged at the free end of arm 13a. The lower part of support 14 exhibits an arm 14a extending laterally towards support 13. A nose 16 is arranged on the free end of arm 14a. The shape of the free end of arm 14a matches the shape of the free end of arm 13a and, more particularly, nose 16 fits groove 15. Nose 16 has preferably a beveled edge to facilitate the engagement with

groove 15. Thus, when the apparatus comes to the position of Fig. 1c, support 13 and support 14 interlock. Furthermore, both supports 13 and 14 are maintained interlocked e.g. by way of means acting on carriages 11 and 12 so as to avoid lateral disengagement from one another. In this way, both supports 13 and 14 form one rigid
5 block: horizontal or vertical relative vibrations between support 11 and support 12 are eliminated.

We will now describe the relationship between rolls 3 and 4, slender roll 5 and winding roll 2 from the mechanical point of view. When the apparatus is in the
10 position of Fig. 1e, i.e. the nominal position for winding efficiently, slender roll 5 acts as a nip roller. The diameter of slender roll 5 is preferably as small as possible in order to minimize the air entrainment between web 1 and winding roll 2. Thus, slender roll 5 becomes flexible over its length and, in the absence of rolls 3 and 4, may bend and vibrate on winding roll 2 while winding. Resonance may even occur.
15 Both, the bending and vibrating of slender roll 5 would adversely result in tangential speed differences between slender roll 5 and winding roll 2 inducing friction on web 1, variations of tension in web 1 and bad effects as regard the spreading of web 1 as well as regards the air entrainment. Thus, it is preferred to avoid the bending and vibrating of slender roll 5 while winding. For that purpose, rolls 3 and 4 flank slender
20 roll 5 on its upper half circumference so as to sandwich it between them and winding roll 2 while winding. Further, rolls 3 and 4 are preferably more rigid than slender roll 5 in order to be able to support slender roll 5: that is preferably obtained with rolls 3 and 4 having a greater diameter than slender roll 5. Rolls 3 and 4 preferably have each a diameter being one to six times, preferably three times, the diameter of slender
25 roll 5. Preferably, rolls 3 and 4 have the same diameter and are positioned at the same vertical level. Further, the surface of roll 3, which is wrapped by web 1 (in this embodiment), is advantageously smooth; preferably, its surface is metallic and polished, its roughness R_t (i.e. the difference between the highest and lowest point of the surface) being lower or equal to 25 μm . In that case, web 1 floats on the
30 aerodynamic boundary layer without contacting the surface of roll 3. This results in a spreading effect. Similarly, the surface of roll 4 is advantageously smooth similarly to roll 3. Slender roll 5 consists preferably in a core with an elastic coating which conforms itself to the surface of winding roll 2. For slender roll 5 having a width up to 2 meters and web 1 being conveyed at a speed up to 1000 meters/min, it is
35 advantageous for slender roll 5 having a diameter of about 50 millimeters and for rolls 3 and 4 having a diameter of about 150 millimeters each. Thus, rolls 3 and 4 allow to position precisely slender roll 5 between them and, as a consequence,

slender roll 5 is correctly positioned on winding roll 2 and further, rolls 3 and 4 provide dynamic stability while winding.

The distance between slender roll 5 and winding roll 2 in Fig. 1d is preferably small so that the time needed to pass from the position of Fig. 1d to the position of Fig. 1e is low, and thus, it limits the time during which slender roll 5 may possibly bend or vibrate under rolls 3 and 4 as it is not in abutment with winding roll 2 yet. The mechanism for ensuring the correct positioning of slender roll 5 between rolls 3 and 4 will be more precisely described in relation with Fig. 3.

Since supports 13 and 14 are preferably interlocked when arriving in position of Fig. 1c as already mentioned and remain interlocked in the subsequent steps (corresponding to Fig. 1d and 1e), relative movement, more particularly vibrations, between rolls 3 and 4 are avoided while winding and thus, it avoids unwished bending and vibrations of slender roll 5 that may be induced by said relative movement or vibrations between rolls 3 and 4.

Further, the apparatus is designed so as to avoid, when in position of Fig. 1e, lateral movement, more particularly lateral vibrations, of the block formed by carriages 11 and 12 with their supports 13 and 14 being interlocked, and thus of rolls 3 and 4 and slender roll 5, relatively to winding roll 2. However, the vertical position of the unit formed by rolls 3 and 4 and slender roll 5 adapts to the diameter of winding roll 2 while increasing during the winding as it was described in relation with Fig. 2. Pressure cylinders 21 and 23 are preferably of pneumatic type in order to define an adjustable contact pressure between winding roll 2 and slender roll 5 and to absorb the eventual vertical vibrations. Pressure cylinders 19 are also preferably of the pneumatic type. As already mentioned, web 1 preferably passes substantially horizontally from roll 6 to roll 3 so that eventually remaining vertical movements or vibrations of roll 3 and slender roll 5 (due to the run out of winding roll 2) do not cause substantial variation of tension in web 1 as it would be the case if web 1 is fed vertically to roll 3.

In the position of Fig. 1e, efforts relative to slender roll 5 are distributed as follows.

The weight W of rolls 3 and 4 (which are interlocked) is supported by winding roll 2 via slender roll 5. Roll 3 and roll 4 have preferably the same weight. However, at least a small amount ΔW of their weight W is preferably supported by pressure cylinders 21 and 23 disposed at each end of said rolls 3 and 4, said pressure cylinders pulling upwards half of that amount, i.e. $\Delta W/2$, at each end. Preferably, amounts ΔW are selected so as to be sufficient for obtaining that the pressure exerted by slender roll 5 on winding roll 2 is maximal in the middle of slender roll 5 and

decreases progressively towards its edges. Nevertheless, the pulling forces $\Delta W/2$ of pressure cylinders 21 and 23 are limited so that slender roll 5 remain in abutment with winding roll 2 over the whole width of web 1. As a consequence, the efficiency of slender roll 5 for diminishing the air entrainment between web 1 and winding roll 5 is further improved as it favors the expulsion of the air caught between web 1 and winding roll 2 from the middle towards the edges of web 1 in the abutment region of slender roll 5 with winding roll 2. In practice, the pulling upward force of $\Delta W/2$ developed by pressure cylinders 21 and 23 on each end are preferably obtained by feeding pressure cylinders 21 and 23 of a differential type (at each end) with a first pressure (a) inducing an upward constant force of $W/2$ and with a second pressure (b) inducing a downward force of $(W/2 - \Delta W/2)$: thus, the resultant force on each end of rolls 3 and 4 is $\Delta W/2$ directed upwards.

As regards the abutment of slender roll 5 on rolls 3 and 4, the reaction forces of slender roll 5 on rolls 3 and 4 due to at least a part of the weight of rolls 3 and 4 supported by winding roll 2 via slender roll 5 are preferably maintained as low as possible, rolls 3 and 4 just avoiding the bending and vibrating of slender roll 5 as well as ensuring its correct positioning. Thus, compression of web 1 between slender roll 5 and roll 3 is maintained low and, as a result, avoids to harm web 1. From that point of view, the angle between the half-plane delimited by the axis of slender roll 5 and comprising the axis of roll 3 and the half-plane delimited by the axis of slender roll 5 and comprising the axis of roll 4 is preferably as low as possible, e.g. 130° . As a result, the efforts of slender roll 5 on rolls 3 and 4 are minimized for a given effort exerted from winding roll 2 on slender roll 5 if relevant.

In practice, winding roll 2 bows slightly downward due to its own weight and due to the fact it is supported on its ends. However, if designed properly, winding roll 2 is more rigid than slender roll 5 and than rolls 3 and 4, and consequently, winding roll 2 bows less downward than might do slender roll 5 and rolls 3 and 4. So, in fact, rolls 3 and 4 and slender roll 5 bow of the same amount than winding roll 2 which continue to support slender roll 5 at least over the width of web 1 as previously described. However, it is preferred that pressure cylinders 19 develop an upward force at each end of slender roll 5 sufficient for ensuring that both end regions of slender roll 5 abut rolls 3 and 4 for any width of winding roll 2.

It is preferred that slender roll 5 abuts the top of winding roll 2 as shown in Fig. 1e (or, in another embodiment, that winding roll 2 abuts the top of slender roll 5). Thus, the tangential speed of winding roll 2 and slender roll 5 as well as the tangential speed of slender roll 5 and roll 3 are substantially identical for each point on the width of web 1, and so no frictions on web 1 are generated. This is not obtained if slender roll 5 abuts laterally winding roll 2, (thus, rolls 3 and 4 flank

slender roll 5 laterally). Indeed, rolls 3 and 4 bow each downward of substantially a same fixed amount (if they are identically designed) and winding roll 2 bows downward with another amount which furthermore varies as its diameter increases due to web 1 wound on it. As a consequence, rolls 3 and 4 do not position correctly 5 slender roll 5 on winding roll 2 over its whole length and it results in differences of tangential speed vectors between roll 3 and slender roll 5 and between slender roll 5 and winding roll 2, thus inducing friction on web 1. Further, slender roll 5 may even slightly vibrate as slender roll 5 is no more correctly sandwiched on all its length between rolls 3 and 4 on one hand and winding roll 2 on the other hand.

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In another preferred embodiment, it is proposed the same apparatus than the one described up to now, but with modified steps compared to those of Fig. 1a to Fig 1e. Initial position of the apparatus is the one of Fig. 1a. Displacement of first carriage 11 and second carriage 12 are similarly executed than described previously 15 for passing from Fig. 1a to Fig. 1c, but lateral displacement distances are modified so that the apparatus reaches the state of Fig. 4 instead of the one of Fig. 1c. Then, slender roll 5 is moved along roll 4 until it contacts roll 3, as previously described for passing from Fig. 1c to Fig. 1d. Then, the block formed by first carriage 11 and second carriage 12 (with their supports 13 and 14 being interlocked as previously) is 20 laterally shifted in order to go in the position of Fig. 1d and then, to the position of Fig. 1e.

In a further preferred embodiment, it is proposed a similar apparatus which allows to gain space following the horizontal direction. In the embodiment shown in 25 relation with Fig. 1a to 1e, 3 is laterally shifted with respect to rolls 8 and 9 which are shown substantially vertically aligned. Similarly, roll 4 and slender roll 5 are laterally shifted with respect to rolls 6 and 7 which are also shown substantially aligned. Thus, when the apparatus is in open state as in Fig. 1a, it takes some place in the horizontal direction. It is for example possible to mount roll 3 on one carriage and 30 rolls 8 and 9 on a further carriage, both being movable laterally. Similarly, roll 4 and slender roll 5 may be mounted on one carriage while rolls 6 and 7 are mounted on a further carriage, both being movable laterally. Thus, when the apparatus is in open condition as illustrated in the previous embodiment by Fig. 1a, it is possible to align approximately vertically rolls 3, 8 and 9 on one side of the path of web 1 between idle roll 10 and winding roll 2 and it is possible to align approximately vertically 35 rolls 3, 8 and 9 on the other side of said path. Thus, it is possible to spare the horizontal distance previously separating rolls 8 and 9 from roll 3 and the horizontal distance separating roll 4 and slender roll 5 from rolls 6 and 7. Then, both carriages

carrying roll 3 and rolls 8 and 9 may be simultaneously moved toward web 1 to abut it and then (or eventually simultaneously) both carriages carrying roll 4, slender roll 5 and rolls 8 and 9 may be simultaneously moved toward web 1 until that rolls 3 and 4 and slender roll 5 are in the position previously illustrated in Fig. 1c. At this stage,
5 rolls 8 and 9 and rolls 6 and 7 form the previously mentioned jaw closed on web 1, but said jaw is then substantially vertically aligned with rolls 3 and 4 and slender roll 5 as shown in Fig. 5. Roll 6 is slightly above rolls 3 and 4 as regards the vertical position. From this position on, the carriage of rolls 8 and 9 and the carriage 6 and 7 are simultaneously shifted in the horizontal direction to get to the position depicted in
10 Fig. 1c and then the subsequent steps of the previous embodiment are normally carried out. However, before operating said shift, it is possible to realize previously the step described for passing from the position of the apparatus described in Fig. 1c to the position of Fig. 1d in the previous embodiment.

15 In the different embodiments described previously, when the apparatus is in the nominal winding position (i.e. position shown in fig. 1e), web 1 passes between roll 3 and slender roll 5 and then between slender roll 5 and winding roll 2. Alternately, it is possible to thread up web 1 through a different path in the device comprising rolls 3 and 4 and slender roll 5 for winding web 1 on winding roll 2.

20 For instance, as shown in fig. 6a, web 1 may first pass between roll 4 and slender roll 5, then between roll 3 and slender roll 5 and finally between slender roll 5 and winding roll 2. In this case, the apparatus has preferably an open position in which slender roll 5 is located on one side of the path of web 1 in course of winding on winding roll 2 and rolls 3 and 4 are located on the other side of the path of web 1
25 in course of winding on winding roll 2. Then, when the apparatus is caused to its nominal winding position (e.g. by moving rolls 3 and 4 and slender roll 5 towards winding roll 2 the location of which may be fixed, or by moving slender roll 5 and winding roll 2 towards rolls 3 and 4 the location of which may be fixed), web 1 will be accordingly threaded up.

30 As shown in fig. 6b, web 1 may also directly pass between slender roll 5 and winding roll 2, without passing between roll 3 and slender roll 5 or between roll 4 and slender roll 5. In this case, the apparatus has preferably an open position in which rolls 3 and 4 and slender roll 5 are all located on a same side of the path of web 1 in course of winding on winding roll 2. Further, rolls 3 and 4 and slender roll 5 preferably have their relative locations already corresponding to those in the nominal winding position. Then, when the apparatus is caused to its nominal winding position (e.g. by moving rolls 3 and 4 and slender roll 5 towards winding roll 2 the location of

which may be fixed, or by moving winding roll 2 towards slender roll 5 and rolls 4 and 5 the location of which may be fixed), web 1 will be accordingly threaded up.

In the embodiments of fig. 6a and 6b, the apparatus preferably still have means for positionning automatically slender roll 5 between rolls 3 and 4 in the nominal winding position. Further, in case winding roll 2 is movable, it is preferably winding roll 2 which moves during winding in the nominal winding position, in order to adapt to the diameter of winding roll 2.

In the embodiments described in relation with fig. 1 to 5, web 1 passes between roll 3 and slender roll 5 and then between slender roll 5 and winding roll 2, when the apparatus is in the nominal winding position. Further, rolls 3 and 4 and slender roll 5 are movable from the open position to the nominal winding position, the location of winding roll 2 being fixed. There are alternate possibilities to define the rolls the location of which is fixed or movable in order to allow an easy thread up. For instance, it is possible to have the location of roll 4 and slender roll 5 being fixed (however, the apparatus preferably still has means for positionning automatically slender roll 5 between rolls 3 and 4 in said nominal winding position) and roll 3 and winding roll 2 movable in order to get into the nominal winding position. Then, it is preferably winding roll 2 which moves during winding in the nominal winding position, in order to adapt to the diameter of winding roll 2.

It is to be understood that in the described embodiments of the invention, the three roll system comprising rolls 3 and 4 and slender roll 5 for winding web 1 on winding roll 2 may be used independently from the jaw formed by rolls 6, 7, 8 and 9.

Of course, the invention is not limited to the embodiments described above.

CLAIMS

1. An apparatus for winding at least one web (1), on a winding roll (2), comprising at least a first roll (3), a second roll (4) and a third roll (5) parallel to one another and to said winding roll (2), said apparatus having a nominal winding position in which:

- said first and second rolls (3, 4) and said winding roll (2) are each in contact with said third roll (5);
- 10 - there is no contact between said first roll (3) and said second roll (4), between said first roll (3) and said winding roll (2) and between said second roll (4) and said winding roll (2);
 - a first angle defined between a first half-plane delimited by the axis of said third roll (5) and comprising the axis (17) of said first roll (3) and a second half-plane delimited by the axis of said third roll (5) and comprising the axis (18) of said second roll (4) is smaller than 180°;
 - a second angle defined between a third half-plane delimited by the axis of said third roll (5) and comprising the axis of said winding roll (2) and a fourth half-plane delimited by the axis of said third roll (5) and comprising an intersection line is greater than 90°, said intersection line being defined as the intersection between the bisector plane of said first angle and the plane comprising the axis (17) of said first roll (3) and the axis (18) of said second roll (4).

wherein said web (1) passes at least between said third roll (5) and said winding roll (2).

2. The apparatus according to claim 1, characterized in that said apparatus has further an open position in which said first, second and third rolls (3, 4, 5) are located out of the path of said web (1) in course of winding on said winding roll (2), the bearings of at least one roll among said first, second and third rolls (3, 4, 5) and said winding roll (2) being movable to enable the change of position from said apparatus between said open position and said nominal winding position.

3. The apparatus according to claim 1 or 2, comprising means (19, 25, 27, 28, 35 29, 30) for causing said third roll (5) to position and align freely between said first and second rolls (3, 4) and said winding roll (2) when said apparatus is in said nominal winding position.

4. The apparatus according to any one of claims 1 to 3, characterized in that, in said nominal winding position, said second angle is substantially 180°.

5. The apparatus according to any one of claims 1 to 4, characterized in that, in said nominal winding position, said third half-plane is substantially vertical.

6. The apparatus according to any one of claims 1 to 5, characterized in that loading means (19) apply forces on the bearings of said third roll (5) so that the end regions of said third roll (5) abut said first and second rolls (3, 4) for any width of 10 said winding roll (2) when said apparatus is in said nominal winding position.

7. The apparatus according to any one of claims 1 to 6, comprising means (11, 12, 19, 20, 21) for moving the bearings of said first, second and third rolls (3, 4, 5) along a common direction not perpendicular to said third half-plane and preferably 15 parallel to said third half-plane, in order to adapt to the diameter of said winding roll (2).when said apparatus is in said nominal winding position, the bearings of said winding roll (2) being held fixed in said nominal winding position.

8. The apparatus according to claim 7, comprising interlocking means (13a, 20 14a, 15, 16) for selectively interlocking the bearings of said first and second rolls (3, 4) so that said first and second rolls (3, 4) are not free to move with respect to each other but together.

9. The apparatus according to claim 7 or 8, comprising loading means (21, 25 23) for acting on the bearings of said first and second rolls (3, 4) with a force having a component parallel to said third half-plane and directed towards said winding roll (2) in order to press said third roll (5) against said winding roll (2) when said apparatus is in said nominal winding position.

30 10. The apparatus according to any one of claims 7 to 9, characterized in that, in said nominal winding position, the axis (31) of said third roll (5) is located at a higher level than the axis of said winding roll (2) and that the weight of said first, second and third rolls (3, 4, 5) is at least partly supported by said winding roll (2) via 35 said third roll (5) whereby said third roll (5) exerts a pressure on said winding roll (2).

11. The apparatus according to claim 10, comprising loading means (21, 23) for acting on the bearings of said first and second rolls (3, 4) with a force having a

component parallel to said third half-plane and directed away from said winding roll (2) so that only a part of the weight of said first and second rolls (3, 4) is supported by said winding roll (2) when said apparatus is in said nominal winding position.

5 12. The apparatus according to claim 10 or 11, comprising loading means (21, 23) for acting on the bearings of said first and second rolls (3, 4) with a force having a component parallel to said third half-plane and directed away from said winding roll (2) so that the pressure applied by third roll (5) on winding roll (2) is maximal in the middle region of said winding roll (2) and diminishes progressively towards its
10 edges when said apparatus is in said nominal winding position.

15 13. The apparatus according to any one of claims 1 to 6, comprising means for moving the bearings of said winding roll (2) along a common direction not perpendicular to said third half-plane and preferably parallel to said third half-plane, in order to adapt to the diameter of said winding roll (2) when said apparatus is in said nominal winding position, the bearings of said first and second rolls (3, 4) being held fixed in said nominal winding position.

20 14. The apparatus according to claim 13, comprising loading means for acting on the bearings of said winding roll (2) with a force having a component parallel to said third half-plane and directed towards said third roll (5) in order to press said winding roll (2) against said third roll (5) backed up by said first and second rolls (3, 4) when said apparatus is in said nominal winding position.

25 15. The apparatus according to claim 13 or 14, characterized in that, in said nominal winding position, the axis of said winding roll (2) is located at a higher level than the axis of said third roll (5) and in that the weight of said winding roll (2) is partly reported on said third roll (5) so that said third roll (5) exerts a reaction pressure on said winding roll (2).

30 16. The apparatus according to claim 15, comprising loading means for acting on the bearings of said winding roll (2) with a force having a component parallel to said third half-plane and directed away from said third roll (5) so that only a part of the weight of said winding roll (2) is reported on said third roll (5) when said apparatus is in said nominal winding position.

35 17. The apparatus according to any one of claims 1 to 16, characterized in that for each roll among said first and second rolls (3, 4) coming in contact with said web

(1), it comprises means for selectively causing said roll either to rotate in a direction and at a tangential speed substantially corresponding to those of said web (1), or to act as an idle roll.

5 18. The apparatus according to any one of claim 1 to 17, comprising means for selectively causing at least said first or second roll (3, 4) either to act as an idle roll, or to rotate in a direction and at a speed whereby, when said third roll (5) is in direct contact with said first or second roll (3, 4), said third roll (5) is driven in rotation by friction in a direction and at a tangential speed substantially corresponding to those of said web (1).

10 19. The apparatus according to any one of claim 1 to 18, comprising means (18, 19, 20) for causing said third roll (5) to run along the circumference of said second roll (4) until said third roll (5) abuts also said first roll (3).

15 20. The apparatus according to any one of claims 1 to 19, characterized in that said third roll (5) is covered by an elastic material.

20 21. The apparatus according to anyone of claims 1 to 20, characterized in that the surface of said first roll (3) has a roughness Rt of less than 25 µm.

22. The apparatus according to anyone of claims 1 to 21, characterized in that the surface of said second roll (4) has a roughness Rt of less than 25 µm.

25 23. The apparatus according to anyone of claims 1 to 22, characterized in that the surface of said first roll (3) is metallic and polished

24. The apparatus according to anyone of claims 1 to 23, characterized in that the surface of said second roll (4) is metallic and polished

30 25. The apparatus according to any one of claims 1 to 24, characterized in that said first and second rolls (3, 4) have the same weight.

35 26. The apparatus according to any one of claims 1 to 25, characterized in that said first and second rolls (3, 4) have the same diameter.

27. The apparatus according to any one of claims 1 to 26, characterized in that the diameter of said first and second rolls (3, 4) is one to six times the diameter of said third roll (5).

5 28. The apparatus according to any one of claims 1 to 27, characterized in that said third roll (5) has a length of about 2 meters and a diameter of about 50 millimeters, said first roll (3) and said second roll (4) having a diameter of about 150 millimeters.

10 29. The apparatus according to any one of claims 1 to 28, characterized in that it further comprises a first set of rolls (8, 9) and a second set of rolls (6, 7), wherein said first set of rolls is located on one side and said second set of rolls is located on the other side of the path of said web (1) and wherein said first set of rolls (8, 9) and said second set of rolls (6, 7) are movable until the rolls (6, 7, 8, 9) of said first and 15 second set of rolls contact said web (1), so that the rolls of said first set of rolls imbricate with the rolls of said second set of rolls with said web (1) being caused to form waves between them, said first and second set of rolls being located upstream with respect to said first, second and third rolls (3, 4, 5).

20 30. A method for winding at least one web (1) on a winding roll (2), using an apparatus according to any one of claims 1 to 29, wherein, in said nominal winding position, said web (1) passes between said third roll (5) and said winding roll (2), but neither between said second and third rolls (4, 5), nor between said first and third rolls (3, 5).

25 31. The method according to claim 30, comprising the step of :
 (i) causing said apparatus to adopt said open position whereby said first, second and third rolls (3, 4, 5) are located at one side of the path of said web (1) towards said winding roll (2) and are preferably located relatively to one another as in said nominal winding position, but not in contact with said winding roll (2);

 (ii) initiating the winding of said web (1) on said winding roll (2);

 (iii) bringing said winding roll (2) and said first, second and third rolls (3, 4, 5) nearer until they adopt said nominal winding position.

35 32. A method for winding at least one web (1) on a winding roll (2), using an apparatus according to any one of claims 1 to 29, wherein, in said nominal winding position, said web (1) passes between said second and third rolls (4, 5), then between

said first and third rolls (3, 5) and finally between said third roll (5) and said winding roll (2).

33. The method according to claim 32, comprising the step of :

- 5 (i) causing said apparatus to adopt said open position whereby said first and second rolls (3, 4) are located at one side of the path of said web (1) towards said winding roll (2) and said third roll (5) is located on the other side of the path of said web (1) towards said winding roll (2);
10 (ii) initiating the winding of said web (1) on said winding roll (2);
10 (iii) bringing said first, second and third rolls (3, 4) and said winding roll (2) nearer until they adopt said nominal winding position.

15 34. A method for winding at least one web (1) on a winding roll (2), using an apparatus according to any one of claims 1 to 29, wherein, in said nominal winding position, said web (1) passes between said first and third rolls (3, 5) and then between said third roll (5) and said winding roll (2), but not between said second roll (4) and said third roll (5).

20 35. The method according to claim 34, comprising the step of :

- 20 (i) causing said apparatus to adopt said open position whereby said first roll (3) is located on one side of the path of said web (1) towards said winding roll (2) and said second and third rolls (4, 5) are located on the other side of the path of said web (1) towards said winding roll (2);
25 (ii) initiating the winding of said web (1) on said winding roll (2) ;
25 (iii) bringing said first, second and third rolls (3, 4, 5) and said winding roll (2) nearer until they adopt said nominal winding position.

30 36. The method according to claim 35, characterized in that step (iii) comprises two substeps consisting in:

- 30 (a) bringing said first, second and third rolls (3, 4, 5) nearer until a predetermined configuration in which said third roll (5) is in contact with said first roll (3) and said second roll (4), said third roll (5) not being in contact with said winding roll (2);
35 (b) bringing said winding roll (2) and the unit formed by said first, second and third rolls (3, 4, 5) nearer until said third roll (5) is in contact with said winding roll (2).

37. The method according to claim 36, characterized in that substep (a) is subdivided in two substeps consisting in :

5 (aa) bringing said first, second and third rolls (3, 4, 5) nearer until a predetermined configuration in which said first roll (3) and said second roll (4) are spaced of a predetermined distance and said third roll (5) is not in contact with said first roll (3) ;

(bb) bringing said third roll (5) nearer said first and second rolls (3, 4) until said third roll (5) is in contact with said first and second rolls.

10 38. The method according to claim 37, characterized in that in step (bb), said second roll (4) is caused to rotate and said third roll (5) is caused to run along the circumference of said second roll (4) whereby said second roll (4) causes said third roll (5) to rotate by friction driving in the direction and at a tangential speed corresponding substantially to those of said web (1).

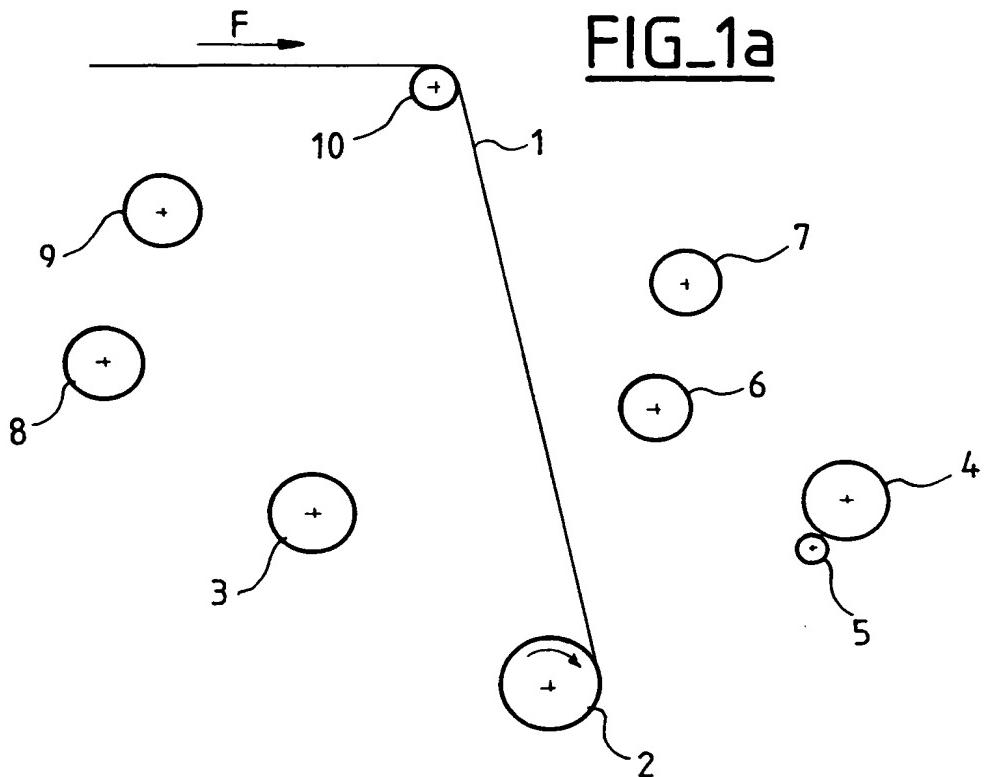
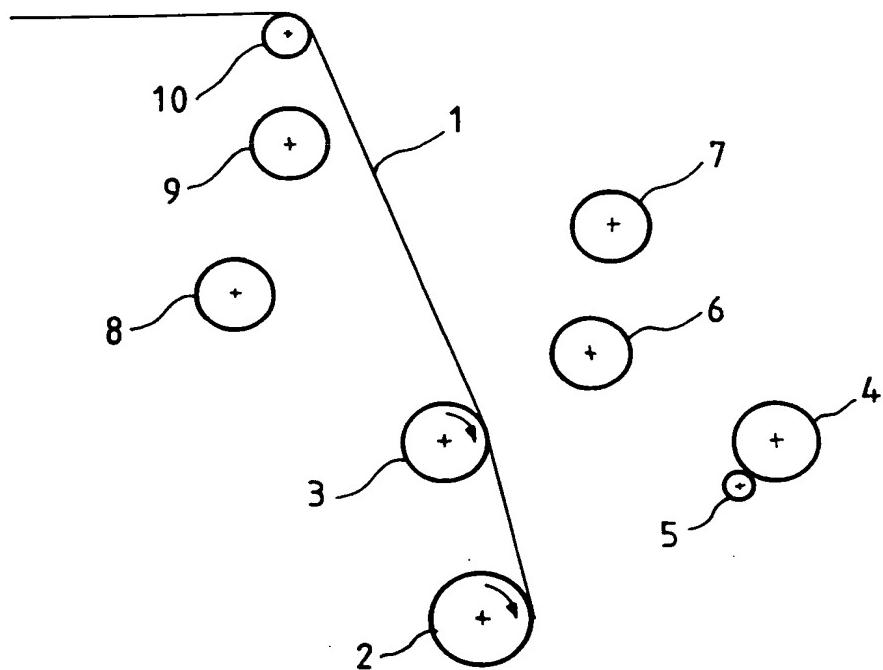
15 39. Method according to any one of claims 31, 33 and 35 to 38, characterized in that in step (iii), each roll among said first and second rolls (3, 4) coming into contact with said web (1) is caused to rotate before contacting said web (1) in the direction and at a tangential speed corresponding substantially to those of said web
20 (1).

40. Method according to any one of claims 31, 33 and 35 to 39, characterized in that in step (iii), said first roll (3) and said second roll (4) are caused to act as an idle roll before said third roll (5) and said winding roll (2) come into contact.

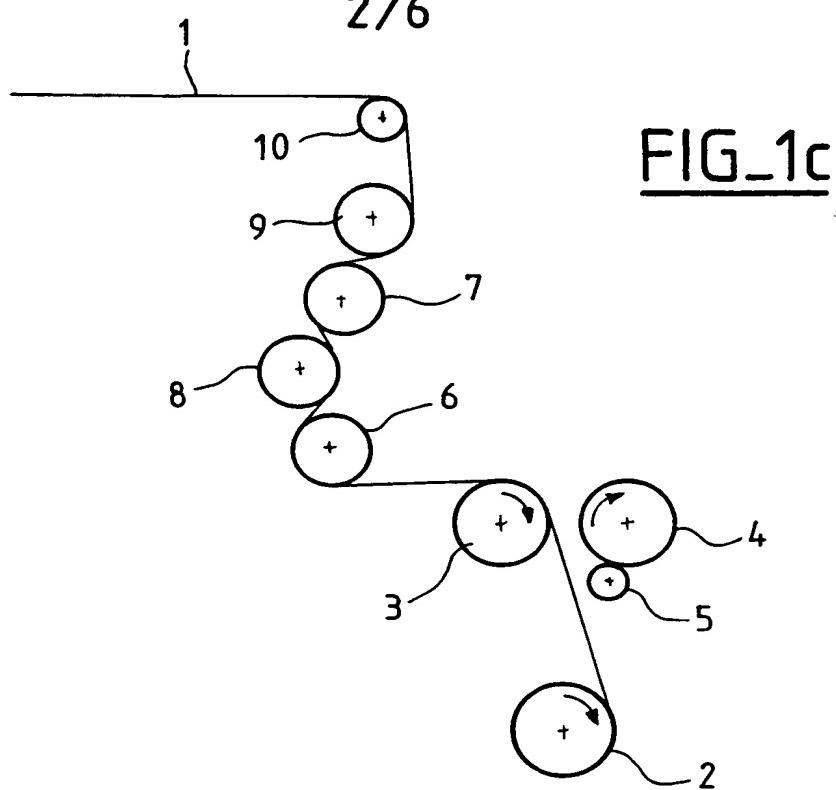
25 41. Method according to anyone of claims 31, 33 and 35 to 39, characterized in that in step (iii), said third roll (5) and said winding roll (2) are brought into contact by a relative displacement along a direction which is not perpendicular to said third half-plane.

30 42. Method according to any one of claims 30 to 41, characterized in that in said nominal winding position, said web (1) is caused to arrive on said first or second roll (3, 4) substantially perpendicularly to said third half-plane.

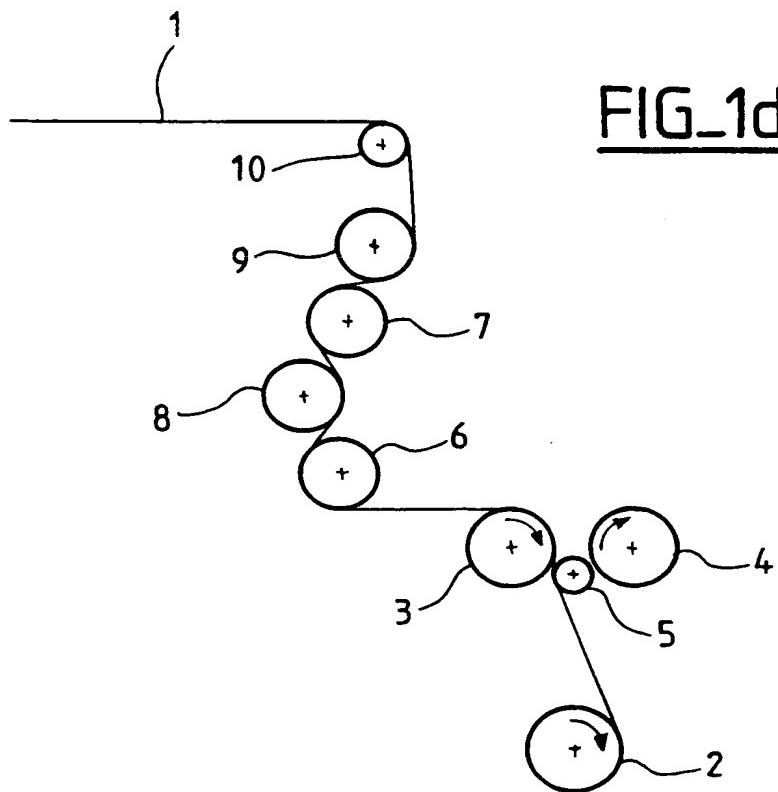
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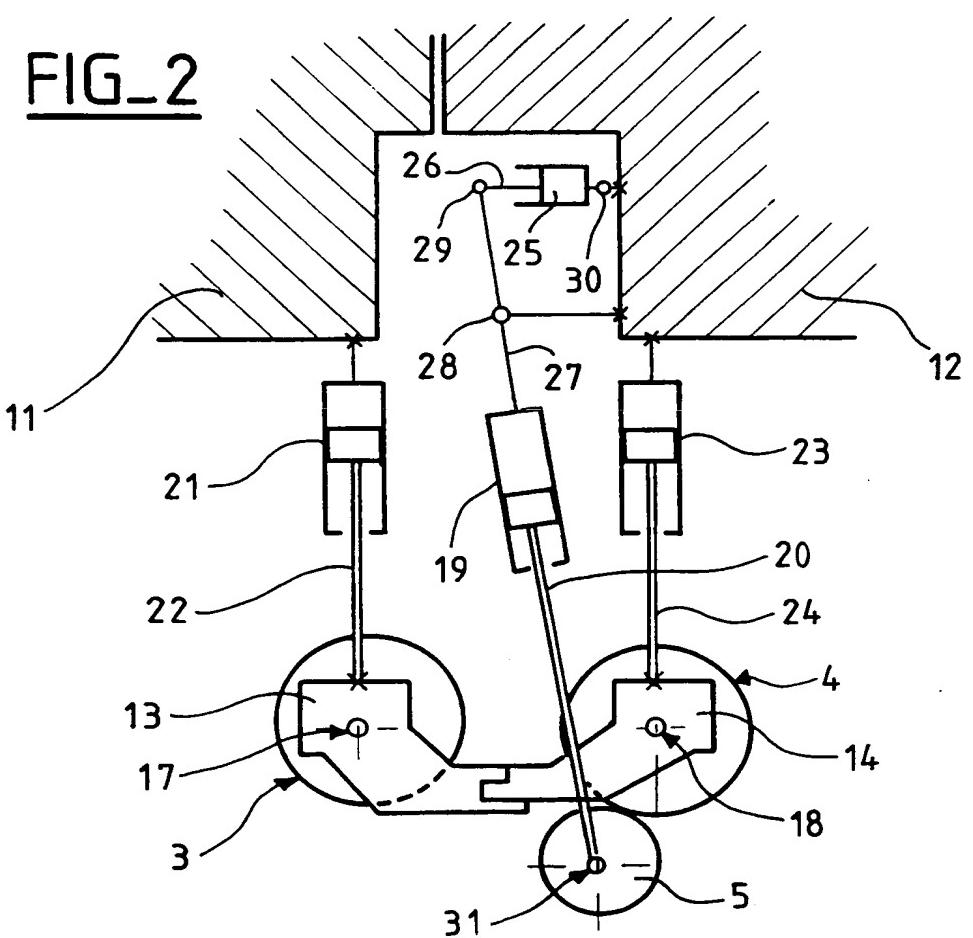
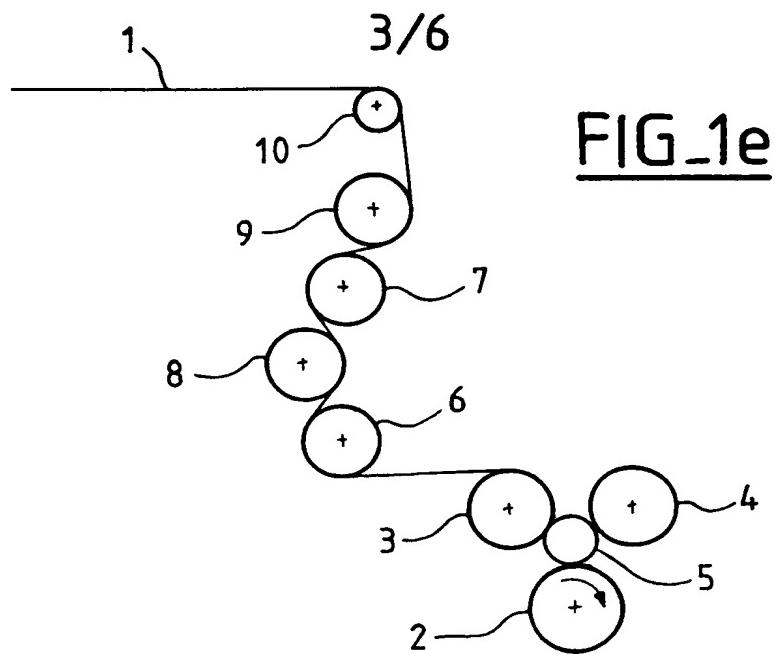
FIG_1aFIG_1b

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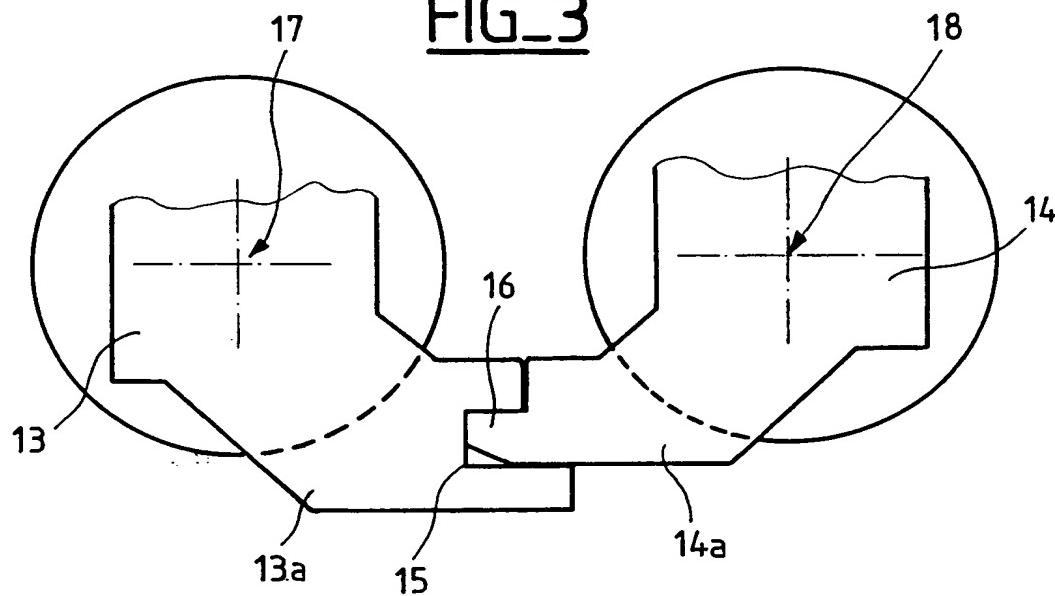
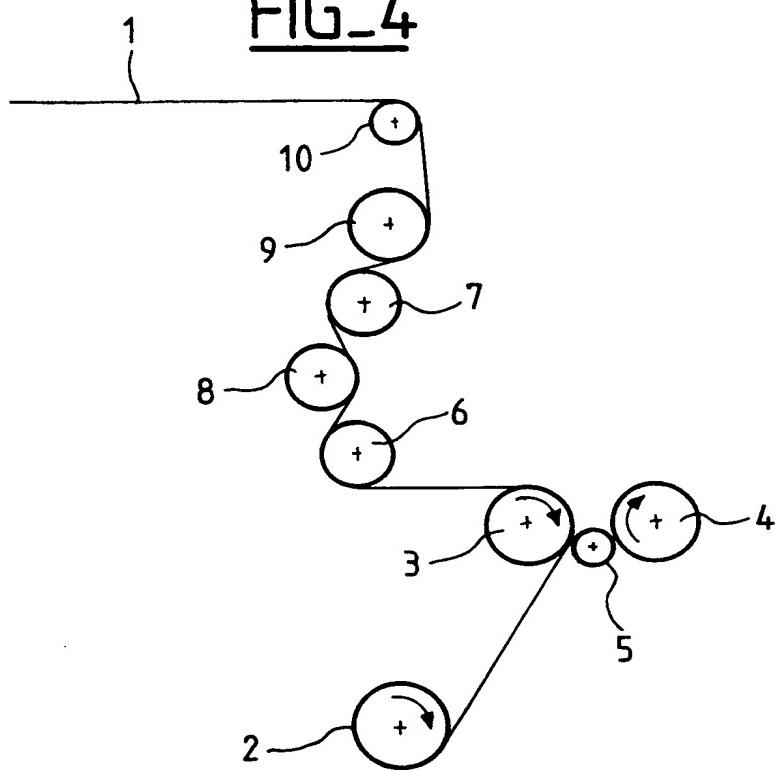


FIG_1d

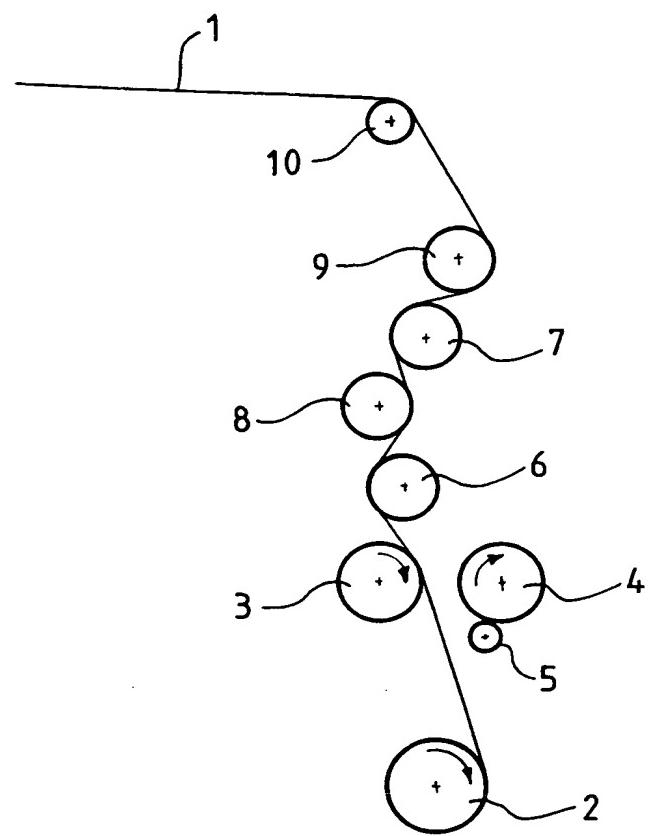




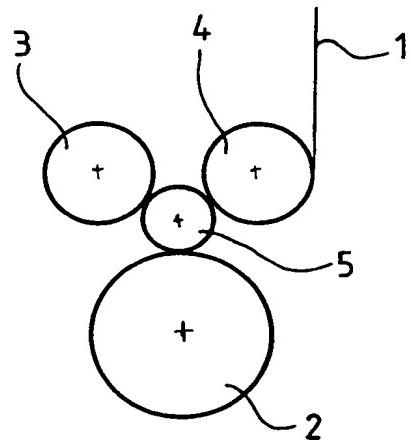
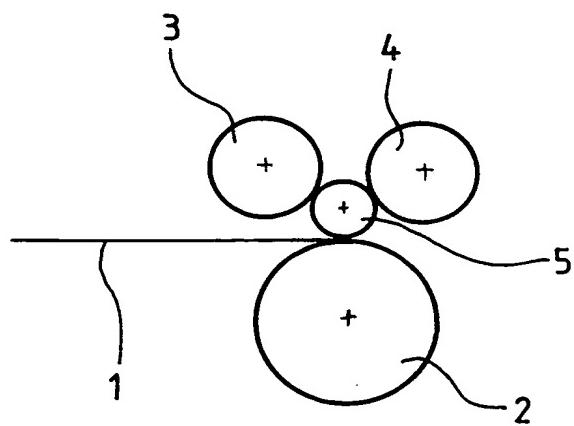
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FIG_3FIG_4

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FIG_5

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FIG_6aFIG_6b

INTERNATIONAL SEARCH REPORT

Inte...inal Application No

PCT/EP 00/05436

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 B65H18/26 B65H18/16

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B65H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 514 226 A (E.I. DU PONT DE NEMOURS AND COMPANY) 19 November 1992 (1992-11-19) column 6, line 17 -column 7, line 41; figures ---	1, 30, 32, 34
A	EP 0 147 115 A (E.I. DU PONT DE NEMOURS AND COMPANY) 3 July 1985 (1985-07-03) page 5, line 10 - line 34; figures 6-8 ---	1, 30, 32, 34
A	PATENT ABSTRACTS OF JAPAN vol. 95, no. 8, 29 September 1995 (1995-09-29) & JP 07 112854 A (MITSUBISHI HEAVY IND LTD), 2 May 1995 (1995-05-02) abstract ---- -/-	1, 30, 32, 34



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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Date of the actual completion of the international search

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

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PCT/EP 00/05436

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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